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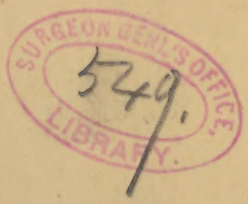

Read at a sanitary convention held in Cleveland, O. Sept 27 1895

PUBLIC WATER SUPPLIES IN THEIR RELATION TO PUBLIC HEALTH.

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Mr. President :—

In the early settlement of this country, the finding of a living spring of pure flowing water frequently determined the location of a future village or city. In all times there has been common knowledge that pure water is essential to health. Nature has kindly looked after man's wants in this direction, and has filled the ground with water and prepared a filter in the upper layers of the earth to remove all impurities from it. We still find in wells and springs, when unpolluted by man, perfectly pure water, cool and refreshing to the taste, and free from germ life. In cities the soil becomes overburdened with filthy matters; cess-pools and vaults—abominations which common decency should never have allowed,—abound, and the wells become polluted and dangerous to use. Increasing demands for water finally lead to the introduction of water works, and a convenient river or lake is made use of to furnish the supply. Vast quantities of filthy substances are washed into the rivers, and carried to the lakes, but still nature's protecting hand, by a series of changes, chemical and biological, converts these substances into harmless inorganic compounds. But as there is a limit to the purifying properties of the soil, so is there also to that of water, and a time comes when the rivers and lakes, especially near the sources of their pollution, no longer afford a safe water supply. Such is the condition of many cities to-day.

When this time comes for any city, one of three things must be done, if any regard is to be had for the life and health of her citizens. First, to stop the pollution of the water supply; second, to purify it; or, third, to secure a new and purer supply. Often the greatest safety will lie in adopting two of these measures—to protect the water against pollution as far as possible, and in addition to purify it.

What evidence is there that impure water may cause disease? We have it from Mark Twain that many a man has come to an untimely end by using bad water—in his whiskey; and the list of diseases which have been attributed to impure water is quite a long one.

It was formerly believed that the presence of decomposing organic matter in water was the chief element of danger. We still measure the amount of dead organic matter in water, not so much because it may itself possibly produce disease as for the reason that water rich in such substances—especially when of animal origin, as from sewage,—is very liable to contain *living organisms* of microscopic size, which are the real source of danger.

River and lake waters usually swarm with germs or bacteria, a glassful often containing millions of them; but this need not alarm us, for all of these may be harmless. Indeed they are usually beneficial, for these minute growths that ordinarily inhabit water are true scavengers, removing from the water much of this dead organic matter, which is objectionable, if not dangerous. We shall have a true idea of bacteriology if we consider that the unseen part of the vegetable kingdom—these bacteria—are comparable to the visible part of vegetation. There are a few poisonous plants which man must destroy or avoid. So there are a few of the many different species of bacteria which are pathogenic or disease producing, and these we must also destroy or avoid.

The list of disease producing bacteria which get into water is not a very long one. Dr. Sternberg describes six-

teen, while Professor Frankland, in his late work on micro-organisms in water, enumerates twenty-three species of such bacteria. Most of these are only rarely present in water, and so far as we now know there are but two diseases which can be properly called water borne diseases; these are Asiatic cholera and typhoid fever. It is highly probable that diarrhœa and dysentery are frequently conveyed through the water supply, and a few other diseases may be, but these will not now be considered.

Cholera possibly may be thought to be of little moment as it so seldom prevails here; but it has recently been knocking at the Golden Gate on the Pacific; and it may be laid down as a rule that any city suffering from a high typhoid fever death rate, due to a polluted water supply, will be in very great danger if cholera should pay us a visit.

Time will not permit of producing all the arguments advanced to prove that typhoid fever is usually a water borne disease, but it may be accepted that a very large majority of all cases are contracted in this way.

It is in fact laid down as a rule that the number of deaths from typhoid fever in any city is usually a fair measure of the purity or impurity of its water supply. This makes the study of typhoid fever of the greatest importance in connection with public water supplies.

It will not be amiss, to clearly understand the subject, to briefly consider the specific cause of typhoid fever. It is the belief of physicians and bacteriologists that the excreta of a person suffering from typhoid fever contain a micro-organism which is capable of producing the same disease on gaining access to the intestinal canal of another person. It is highly probable that it does not always produce disease, when swallowed, and that a certain but unknown number of these organisms must be taken into the system to cause sickness. The typhoid bacillus, as might be inferred, finds in the body the conditions most favorable for its growth. A question of very great importance is, will it live outside of

the body for any length of time, and if so, will it grow and multiply, so that a few germs getting into water may produce many? This question cannot be positively answered. It is probably true that under certain conditions—mostly artificial—this germ may multiply outside of the human body, but there is reason to believe that this seldom takes place, and especially in surface waters such as lakes and rivers. But while they do not ordinarily multiply they undoubtedly may live some time in water, milk, or in the soil. They have been found in ice, so that freezing does not destroy them. Experiments made at the Lawrence, Mass., Experiment Station proved that they existed for twenty-eight days in unfiltered Merrimac River water. We may state positively that when the germs of typhoid fever gain access to a supply of drinking water they may live and remain active for at least two weeks—a period sufficient in many cases to produce serious mischief.

It is easily understood how water supplies become contaminated with typhoid fever germs. They get into wells by leachings from cess-pools and vaults, or by surface washings, and into rivers and lakes by the sewage discharged into them. This pollution may be temporary, resulting, possibly, in a great and sudden outburst of the disease, or it may be more or less continuous, and one might almost say premeditated, in view of present knowledge, causing a continuously high death rate from the disease. A familiar example of the former is the epidemic which occurred at Plymouth, Pa. Here the stools of a single case of typhoid fever, washed by melting snows into the city's impounding reservoir, resulted in 1104 cases of the disease and 114 deaths. Examples of the other kind, of the more or less continuous prevalence of typhoid fever due to drinking a sewage laden water, may, unfortunately, be found on all sides.

First, that we may have a basis for comparison, let us consider the prevalence of typhoid fever in a few of the

cities which have a naturally pure water supply, or one which is purified by artificial means.

In 1893, London had 719 deaths from typhoid fever, which equals 17 per 100,000 inhabitants. London obtains its supply almost entirely from the Thames and Lea rivers, both of which are subject to pollution; but all this water is filtered, and repeated examinations have shown that nearly 99% of all micro-organisms in the river water is removed by the filters. Berlin in the same year had 161 deaths from typhoid fever, or 9 per 100,000 inhabitants. Berlin is also using a dirty river water supply, but filters it, and removed on an average 99.6% of all bacteria during that year. Vienna, using pure spring water, had but 7 deaths per 100,000 inhabitants from typhoid fever in 1893.

Taking some of the cities of the United States for the census year 1890, when the population is known, and we find in a list of 50 of the largest cities not one with as low a rate as even London with her 17 per 100,000 population. Allegheny City, which we know has a badly polluted water supply, had 217 typhoid deaths per 100,000 inhabitants. New Orleans is at the other end of the list, with but 19 per 100,000. Looking to Ohio, where our greatest interest lies, and we find 25 for Dayton, with a water supply from wells, 39 for Toledo, with water from the Maumee River, 43 for Columbus (and a part of each year our water supply is badly polluted), 51 for Cincinnati—where I suspect few people drink water, other beverages being so abundant and the water so bad,—and 63 per 100,000 inhabitants in your own City of Cleveland.

But it is hardly fair to judge this matter from a single year, when exceptional conditions may have been present in one or the other of these places. Taking a seven year period ending with 1894, and the reports of deaths made by the local boards of health, and we find, stating the matter in another way to avoid questions as to increase of population—that in Toledo and Dayton 1.99 and 2.02 per cent

respectively, of all deaths were due to typhoid fever. In Cincinnati it was 2.78 per cent, in Cleveland 2.97 per cent, and in Columbus, to our shame be it said, 3.87 per cent of all deaths in that time were due to typhoid fever. Two thousand eight hundred and eighty-two deaths have occurred from typhoid fever in these cities in the past seven years. And this is not all of it, for undoubtedly many people who contracted the disease in these places died elsewhere.

Many authorities tell us we should multiply the deaths by ten to arrive at the number of cases. That is, that about one in ten of those who have typhoid fever die of the disease. Doing this and it appears that we have had about twenty-nine thousand cases of typhoid fever in Ohio's five largest cities in seven years. If, as we believe, fully three-fourths of these cases could have been prevented by furnishing the people pure drinking water, is it not time that ways and means were found to guard against this needless sacrifice of life and health?

Let us look at one or two examples showing how this may be done, and which at the same time strengthen the claim that typhoid fever is a water borne disease.

Prior to 1893 the water supply of Chicago was notoriously bad. During a part of the time a portion of the supply was taken from a short tunnel into Lake Michigan, known as the shore inlet, and intended for fire emergencies only. This supply was badly polluted by sewage from the Chicago River, as was also, at times, a supply obtained from a crib farther out in the lake. In the year 1892 there were 1489 deaths from typhoid fever in Chicago, or 103 per 100,000 inhabitants. In December of that year this shore inlet was closed and a large part of the supply was taken from the new four mile tunnel. In 1893 there were 41 per 100,000 inhabitants and in 1894 but 31, which was 2.05% of the deaths from all causes, the lowest rate in any year since 1851.

The city of Frankfort, Germany, affords a striking ex-

ample of what may be done by engineering works in reducing the deaths from typhoid fever. Prior to 1867 the city was using a badly polluted water supply and was practically without sewerage. The yearly deaths from typhoid fever ranged from 100 to 110 per 100,000 inhabitants. Sewerage works were commenced in 1867, and a pure water supply was introduced in 1872. In 1875, when 52 per cent of the houses were joined to the new water supply and 43% of the houses to the sewers, the typhoid fever deaths had fallen to 42 per 100,000 inhabitants. Ten years later, when 84% of the houses were joined to the new water supply and 77% to the sewers, there were 13 deaths per 100,000 from typhoid fever; while for 1893, 98% of the houses being supplied with pure water and 96% connected with the sewers, there were but 4 deaths from typhoid fever per 100,000 inhabitants. You will note that for each period the per cent of decrease of typhoid deaths corresponds closely with the per cent of increase in the use of pure water.

It has already been noted that Chicago was able to reduce her typhoid rate by more than 60% by going farther into the lake for water. Examples can be given to show that equally good results may be obtained by the artificial purification of a polluted water supply; and it is fortunate that this is so, for many cities are unable to secure naturally pure water.

Lawrence, Mass., is on the Merrimac River, which receives the sewage of Lowell only nine miles above. Both cities have suffered severely from typhoid fever, and an epidemic in Lowell always meant an epidemic in Lawrence. Both cities used unfiltered Merrimac River water. In Lawrence, for five years prior to the introduction of filtered water, the average annual number of deaths from typhoid fever was 127 per 100,000 inhabitants. Since September, 1893, all the city's water has been purified by sand filtration, and in the year following the typhoid deaths dropped to 13 per 100,000, a reduction of 60%. Lowell during that time

suffered from an epidemic of typhoid fever, and infected sewage must have been discharged into the river only nine miles above Lawrence's filter beds.

I cannot refrain from citing an example, though it must be familiar to many of you, which shows in the most striking manner the difference, with respect to the production of cholera, in those using a pure and an impure water supply.

Hamburg and Altona both obtain public water supplies from the river Elbe, Altona at a point seven miles below the discharge of the sewage of both cities, and Hamburg seven miles above. Elbe is a tidal river, and sewage is undoubtedly at times carried to Hamburg's water intake. The cities are practically one, separated only by an imaginary line. The people were living under the same conditions, except that the citizens of Hamburg were drinking unfiltered river water, while the water for Altona was filtered, when the last cholera epidemic made its appearance in Hamburg; nearly seventeen thousand cases and over eight thousand deaths occurred from the disease in Hamburg, or over 26 cases for each 1,000 inhabitants. In Altona, where the water supply, except for filtration, was infinitely worse, receiving all of Hamburg's sewage and its own, there were less than 4 cases per 1,000 inhabitants. Prof. Koch, who investigated this epidemic to determine the efficiency of sand filtration of water supplies, reported that nearly all of the cases in Altona had been contracted in Hamburg, and that the filters had proved an efficient barrier against the disease.

There is another lesson to be learned from Hamburg's experience. The health authorities had repeatedly called attention to the danger of using such a water supply, but the matter was allowed to drag along until the year 1891, when the construction of filters was commenced. But the cholera came in 1892, before the works could be completed, and nearly ten thousand citizens paid the penalty of this procrastination with their lives.

Bringing this question home to the city of Cleveland, it is apparent that the present water supply is far from what it should be, although other cities may be worse off. But you are to be congratulated on having now taken steps to secure purer water. Each of you should feel that the purest water that money and engineering skill can obtain is none too good for a Clevelander.

London, though having a filtered water supply of much greater purity than that of most American cities, is seriously considering the expenditure of thirty-eight millions of pounds to secure still better water. Boston has accepted plans and estimates calling for thirty millions of dollars for a larger and better water supply. Whole villages will be bought and removed from the water shed in order to preserve the water's purity. Cleveland, with a perfectly pure water supply, and the satisfactory disposal of her sewage, will have cast off a very great impediment in her progress towards becoming the first city of the lakes.

Permit me to add one word as a representative of the State Board of Health. In 1893 the Ohio Legislature enacted a law providing that no city or village should introduce, change or extend a public water supply or sewerage system without the approval of the State Board of Health. This act is in line with what has been done in Massachusetts, New York, and Minnesota, but is far short of the powers conferred upon the boards of health of the two former states. The intention of the act is obvious, and its proper enforcement will tend largely to prevent arising the deplorable conditions now existing in many of our cities and towns. In some instances the Board has perhaps appeared at first sight in the light of an obstructionist to needed public improvements, but I can say with the greatest sincerity that in all its acts it has been guided by the sole desire to give the people the best attainable conditions for the preservation of health.